Near-Road Monitoring

Daniel Garver

U.S. Environmental Protection Agency Region 4

April 27, 2011

EPA United States Environmental Protection Agency

Outline

1. Health Effects
2. NO_2 and CO Monitoring Rule Requirements
3. Near-road Technical Assistance Document (TAD)
4. NO_2 Pilot Study
5. Site Selection Case Study

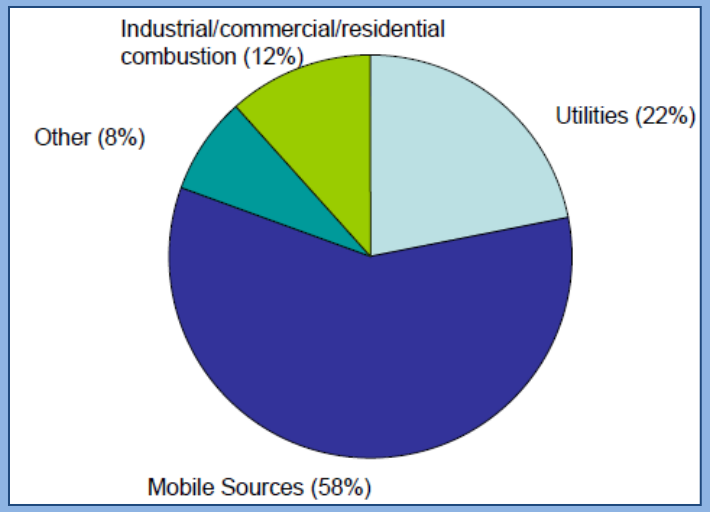
EPA United States Environmental Protection Agency

NO_2 Health Effects

- Short-term NO_2 exposures, ranging from 30 minutes to 24 hours, linked with:
  - Increased asthma symptoms
  - Worsened control of asthma
  - Increase in other respiratory illnesses and symptoms
- Studies also show a connection between short-term exposure and increased emergency room visits for respiratory illnesses, particularly in children, the elderly, and asthmatics

Traffic-Related NO_2 Exposure

- NO_2 concentrations on or near major roads are higher than those measured by the current monitoring network
  - In-vehicle concentrations can be 2-3 times higher than measured at nearby community-wide monitors
  - Near-roadway concentrations have been measured to be approximately 30 to 100% higher than nearby concentrations
- Short-term NO_2 exposures on or near major roads can be considerably higher than measured by the current network



EPA United States Environmental Protection Agency

Newly Required near-road Monitoring Networks

- **NO_2**
  - At least one monitor in core based statistical areas (CBSAs) with population greater than or equal to 500,000
  - A second monitor in areas with either:
    - population ≥ 2.5 million, or
    - one or more road segments with an annual average daily traffic count (AADT) ≥ 250,000 vehicles
- **CO** (proposed)
  - Collocation with NO_2 monitors in CBSAs with population ≥ 1 million

EPA United States Environmental Protection Agency

Monitor Location & Siting Requirements

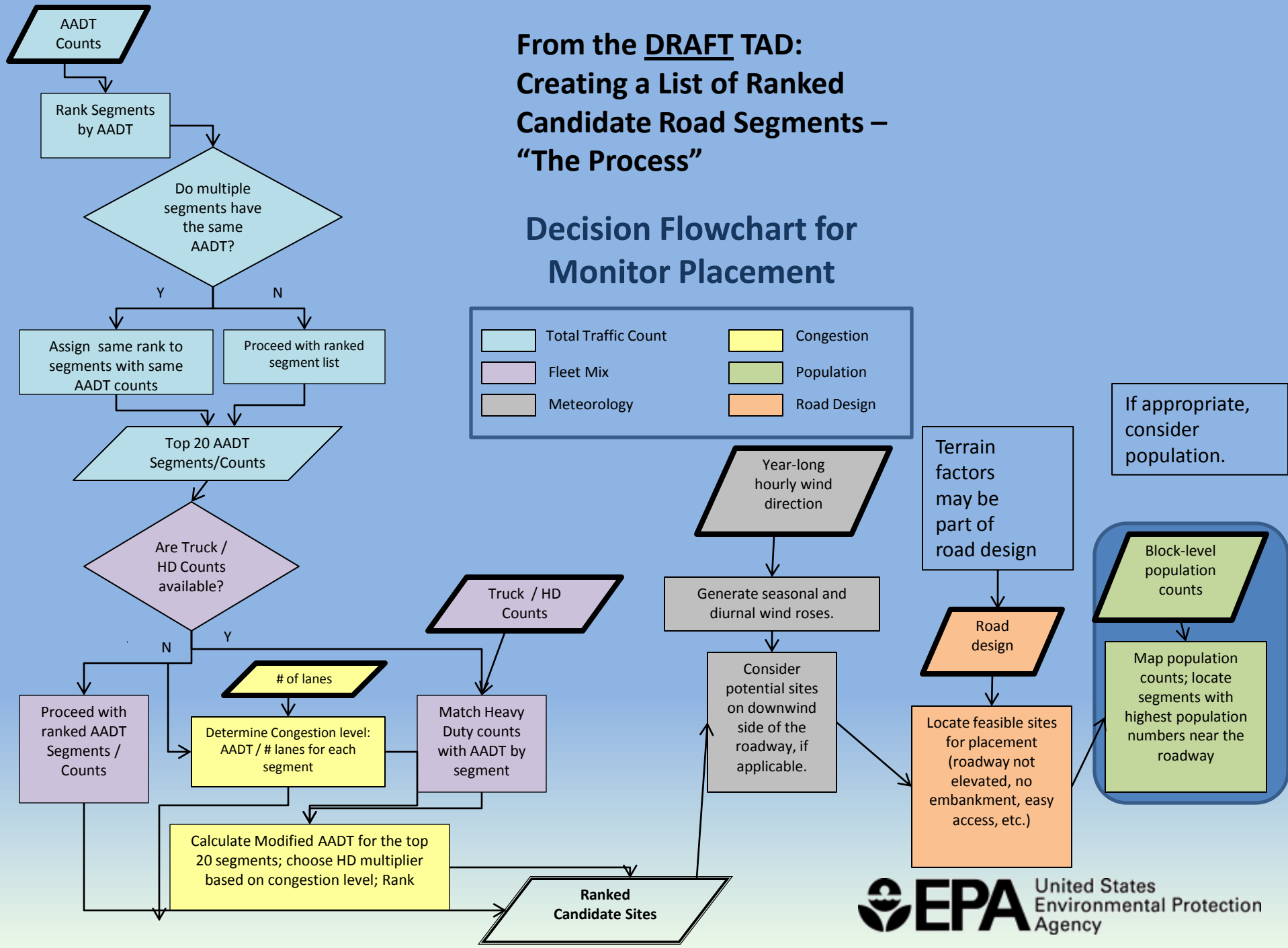
- Rank all road segments in a CBSA by AADT count
- Identify monitoring location(s) near highest ranked segments considering:
  - Fleet mix
  - Roadway design
  - Congestion patterns
  - Terrain
  - Meteorology
- Monitor siting requirements
  - Near as practicable to the edge of the nearest traffic lanes
  - Not more than 50 meters away

Near-road Monitoring Technical Assistance Document (TAD)

- In response to public feedback requesting further guidance on implementing the near-road NO_2 network, EPA committed to create the near-road monitoring TAD.
- EPA and NACAA have established a workgroup to develop the TAD.
- The TAD will suggest concepts for use by State and Locals to implement the network in a way that meets the intentions and physical requirements of the NO_2 rulemaking.
- The TAD will also discuss the merits, methods, and approaches for making near-road NO_2 stations multi-pollutant monitoring stations.
- Draft TAD due May/June – specifically for review by CASAC-Ambient Air Monitoring and Methods Subcommittee.
- Final TAD expected Fall of 2011
- In addition to the TAD, some state and local agencies are conducting a near-road NO_2 pilot, collaborating with EPA

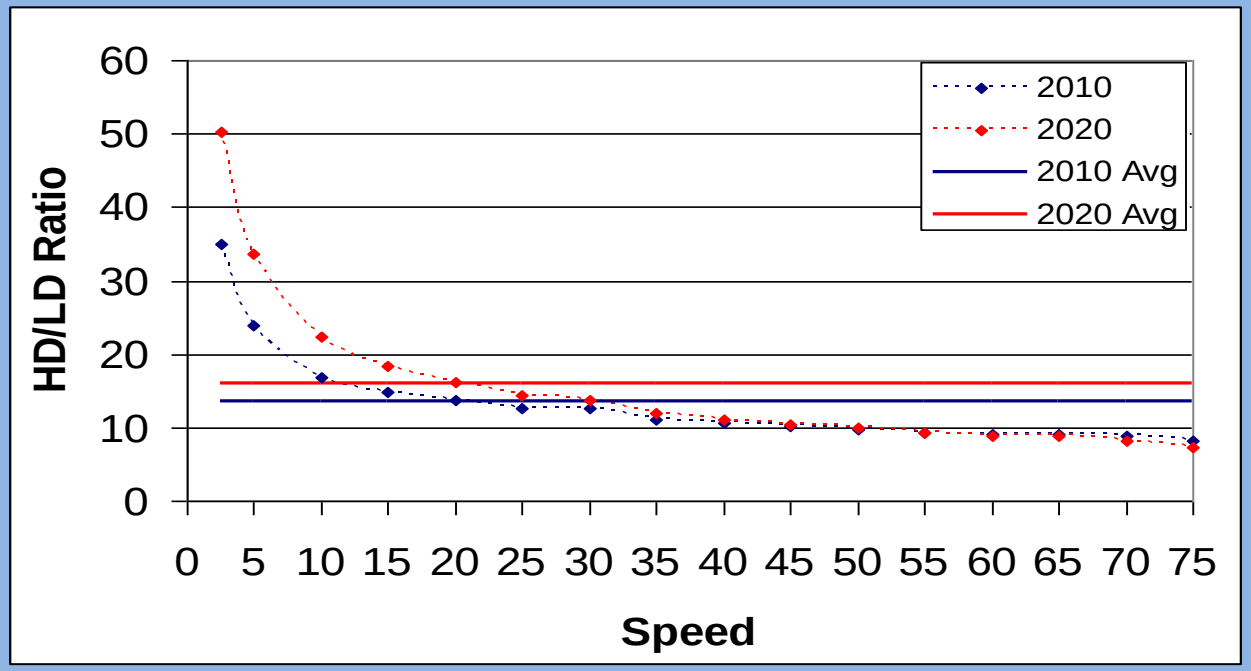
From the DRAFT TAD: Creating a List of Ranked Candidate Road Segments – "The Process"

Decision Flowchart for Monitor Placement



EPA United States Environmental Protection Agency

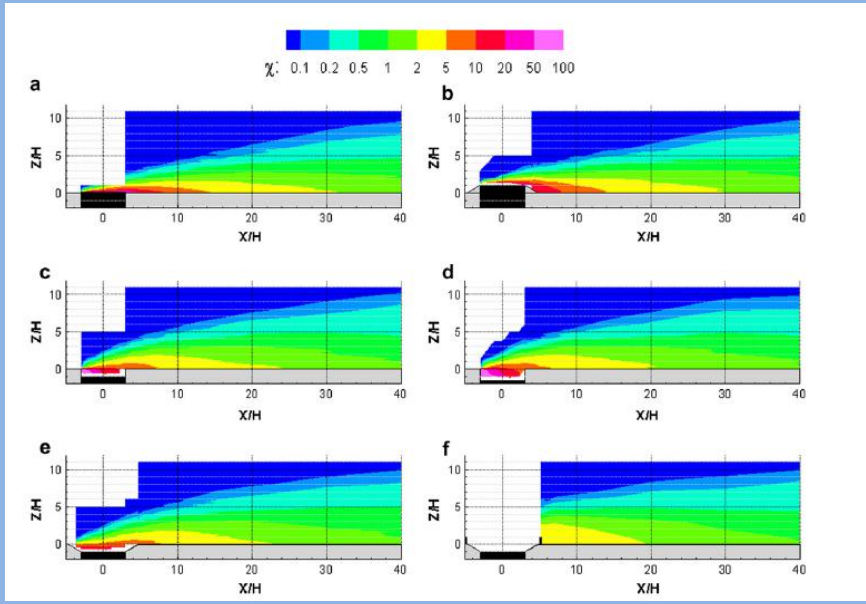
Fleet Mix: NO_x Emission Rates



- Data from EPA's regulatory MOVES (MOtor Vehicle Emissions Simulator) model using national defaults
- Ratios of HD/LD emissions ~13.5 (2010) and 16.0 (2020)
  - Ex. 2010 Weighted AADT = LD AADT + 13.5 * (HD AADT)
- Ratios vary by speed
  - Low speed: higher HD/LD ratio (>15)
  - High speed: lower HD/LD ratio (<10)
- Preliminary data includes cold starts
- Ratio is closer to 1:1 for CO emissions

EPA United States Environmental Protection Agency

Roadway Design, Terrain, and Meteorology



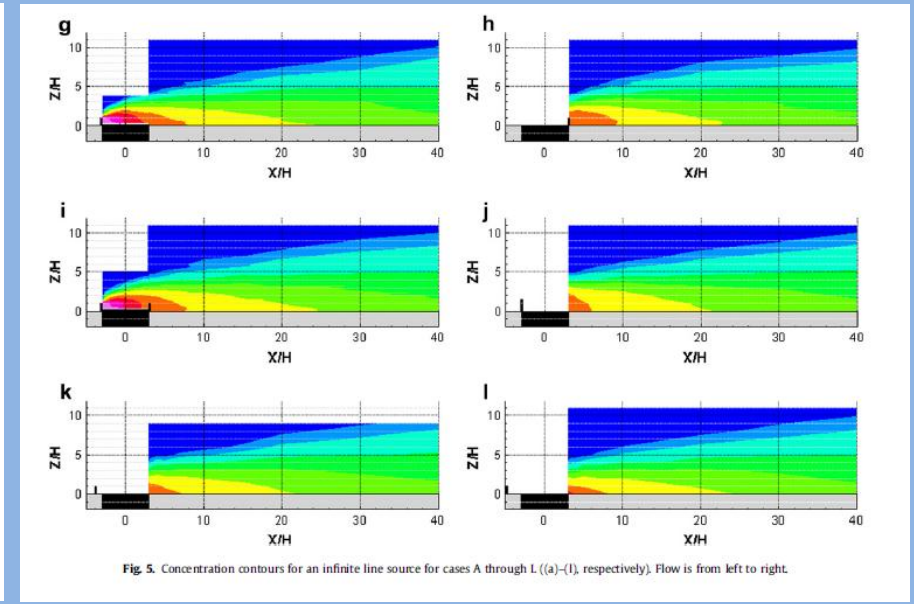


Fig. 5. Concentration contours for an infinite line source for cases A through L ((a)–(l), respectively). Flow is from left to right.

Concentration contours for an infinite line source.
Flow is from left to right. (Heist et al., 2009)

EPA United States Environmental Protection Agency

Near-road NO_2 Pilot Study

The pilot is intended to:

1) Allow air monitoring agencies to evaluate, improve, and document (with EPA) the near-road monitor siting process
2) Provide first-hand experience in the full installation of a near-road monitoring station to share with the air monitoring community

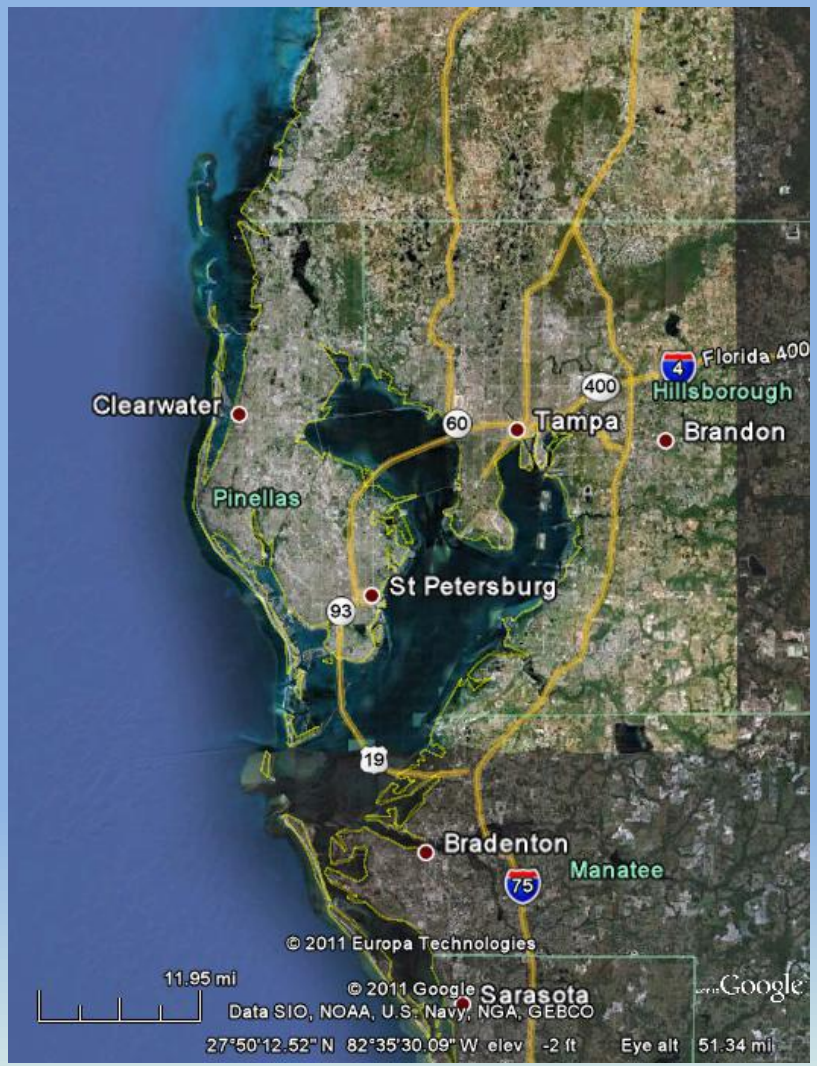
- Five Pilot CBSAs: Albuquerque, Baltimore, Boise, Miami, and Tampa
  - Passive NO_2 monitoring at select roadside locations
  - Boise and Miami (Broward Co.) will install permanent near-road monitoring stations to further meet our second pilot objective
  - EPA will model select road segments

Near-road NO_2 Pilot Study (cont.)

- TAD will discuss different approaches for evaluating candidate near-road sites including:
  - Passive monitoring
  - Periodic continuous (or saturation type) monitoring
  - Mobile (on-road) monitoring
  - Modeling
- EPA plans to utilize any information and experience gained in the pilot study to bolster TAD development.
  - Specifically, evaluate traffic data based selection process with passive monitoring data and modeling

Case Study - Tampa

- Population: approximately 2.7 million
  - Will be required to operate 2 near-road NO_2 monitoring stations
- Three major interstates:
  - I-75 running North-South (on the eastern fringes of Tampa)
  - I-4 running roughly East-West
  - I-275 which runs N-S through Tampa, across the bay to St. Pete, and continues south and east to rejoin I-75
- Comparison of Federal Highway Administration Highway Performance Monitoring System (HPMS) data versus local Florida DOT data in the following slides



EPA United States Environmental Protection Agency

Case Study - Variables Presented

- For this example (Tampa CBSA), we are providing a list of the top ranked road segments (using available data) based on:
  - AADT (total traffic volume)
  - Heavy Duty(HD) vehicle counts (e.g. trucks/buses)
  - Estimate of congestion by calculating total AADT/# lanes on each road segment (akin to Level of Service [LOS] provided by DOTs)
  - Fleet Equivalent (FE) AADT – which accounts for AADT and fleet mix when data are available
    - FE AADT = (AADT – HD counts)+(HD counts * 10)
    - The "10" value in the equation is the Heavy Duty to Light Duty vehicle NOx emission ratio.

Comparison of HPMS and FL DOT Traffic Data

	HPMS	Florida DOT
Source	http://www.bts.gov/publications/national_transportation_atlas_database/2010/	http://www.dot.state.fl.us/planning/statistics/trafficdata/
Year	2008	2011
1st	204,000 (I-275)	192,000 (I-275)
2nd	201,000 (I-275 & ramp to I-4)	176,500 (I-275)
3rd	187,000 (I-275)	170,500 (I-275)
4th	175,500 (I-275)	169,000 (I-275 & ramp to I-4)
5th	172,500 (I-275)	167,000 (I-275)

EPA United States Environmental Protection Agency

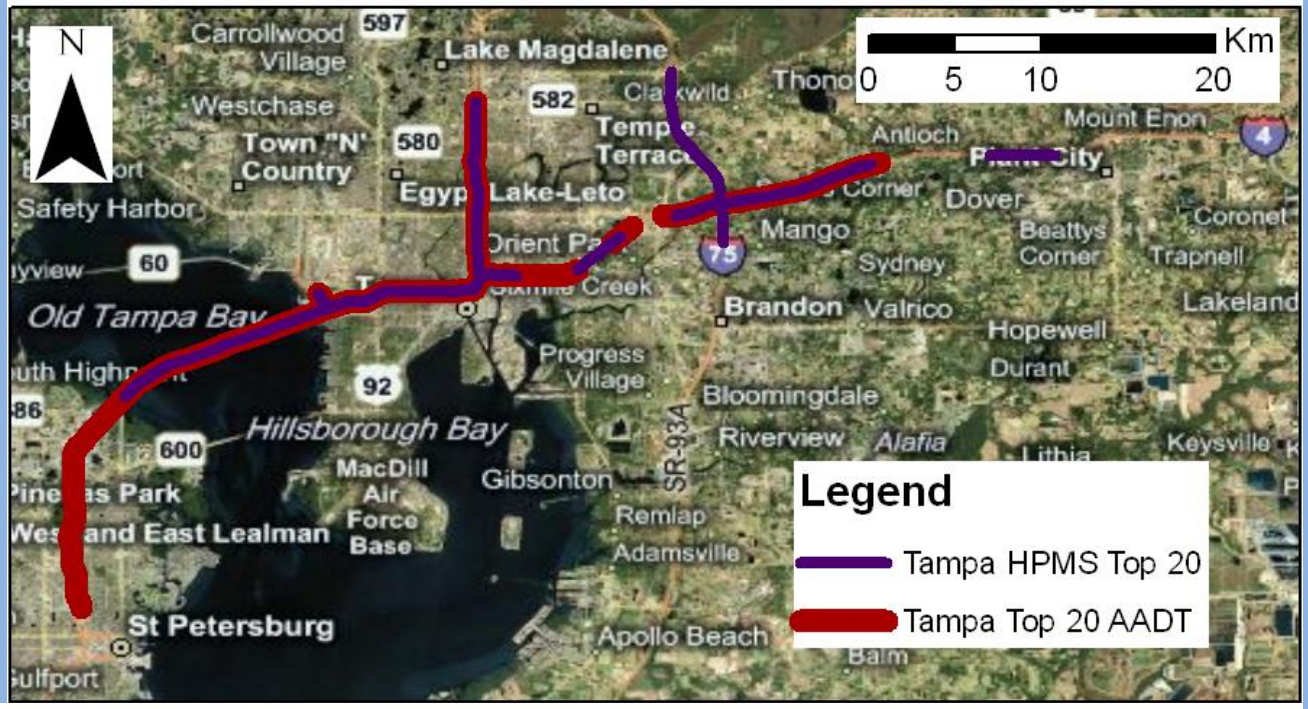
Example of Differences Between HPMS and Local Counts

EPA United States Environmental Protection Agency

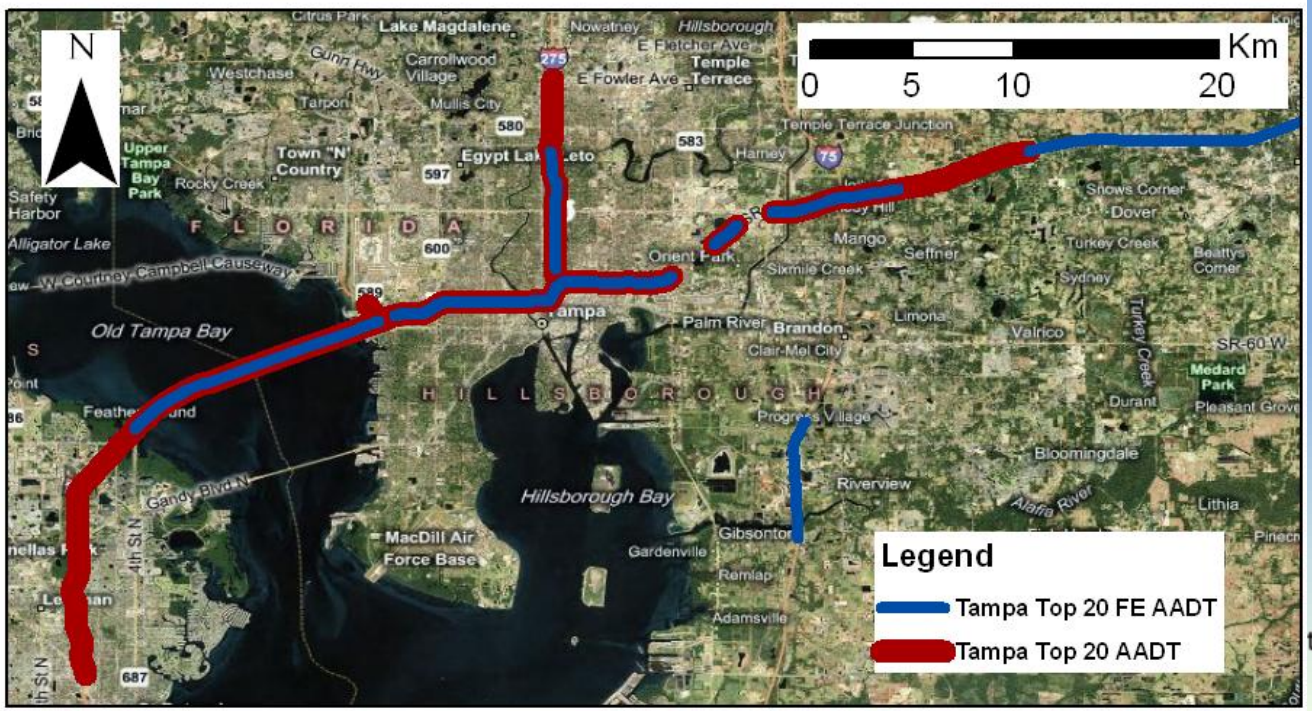
Tampa: Top 20 Fleet-Equivalent (FE) AADT Counts (Local Data)

COSITE	Route	From	To	AADT Rank	AADT	Truck Rank	Truck AADT	AADT/Lane	FE AADT	FE AADT Rank
102028	I-4	10320000/10320001	Bridge No-100658	6	**164,000**	10	**12,251**	16,400	**274,259**	1
102016	I-275	Bridge No-100128	Bridge No-100110	1	**192,000**	27	**8,467**	19,200	**268,203**	2
100091	I-4	US 301 / SR 43	I-75/SR 93A	15	**136,500**	5	**14,073**	17,063	**263,157**	3
102026	I-4	Bridge No-100658	US 41/SR 599/50th St	13	**151,000**	11	**12,050**	18,875	**259,450**	4
105353	I-4	SR 93A/I-75	Mango Rd	15	**136,500**	6	**13,172**	22,750	**255,048**	5
105609	I-275	S600/U92/Dale Mabry	Bridge No-100128	3	**170,500**	25	**8,713**	21,313	**248,917**	6
100087	I-4	Bridge No-100599	S566/Thonotosassa Rd	25	**110,000**	3	**15,279**	13,750	**247,511**	7
100084	I-4	Bridge No-100607	Hills/Polk Co Line	28	**105,000**	1	**15,719**	17,500	**246,471**	8
102006	I-275	Sligh Ave	Bridge No-100219	5	**167,000**	26	**8,684**	27,833	**245,156**	9
102015	I-275	Bridge No-100138	10320000/10320001	4	**169,000**	29	**8,298**	12,071	**243,682**	10
102015	I-275	Bridge No-100110	Bridge No-100138	4	**169,000**	29	**8,298**	16,900	**243,682**	10
102009	I-275	Floribraska Ave	Bridge No-100203	8	**160,500**	21	**9,229**	20,063	**243,561**	11
102019	I-275	CR587/Westshore Blvd	Bridge No-100120	2	**176,500**	36	**7,413**	29,417	**243,217**	12
100112	I-4	Bridge No-100605	Bridge No-100607	29	**103,000**	3	**15,388**	17,167	**241,492**	13
102018	I-275	Bridge No-100120	S600/U92/Dale Mabry	7	**163,000**	32	**7,824**	20,375	**233,416**	14
100106	I-4	Mcintosh Rd	Bridge No-100599	22	**117,932**	8	**12,595**	19,655	**231,287**	15
150062	I-275	East End Br 150107	Bridge No-100115	14	**147,000**	22	**9,026**	18,375	**228,234**	16
150062	I-275	4th St N	End Bridge 150107	14	**147,000**	22	**9,026**	14,700	**228,234**	16
100086	I-4	S566/Thonotosassa Rd	Bridge No-100605	30	**98,000**	4	**14,396**	16,333	**227,564**	17
102007	I-275	SR 600 / Hills Ave	Sligh Ave	10	**156,500**	34	**7,669**	26,083	**225,521**	18
100146	I-75	GibsontonDr	SR 43 / US 301	24	**111,500**	9	**12,577**	11,150	**224,693**	19
102023	I-4	SR 574/ML King Blvd	Orient Rd	20	**122,000**	13	**11,236**	20,333	**223,124**	20
102008	I-275	Bridge No-100203	SR 600 / Hills Ave	11	**153,500**	33	**7,736**	25,583	**223,124**	20

National Counts
vs.
Local Counts

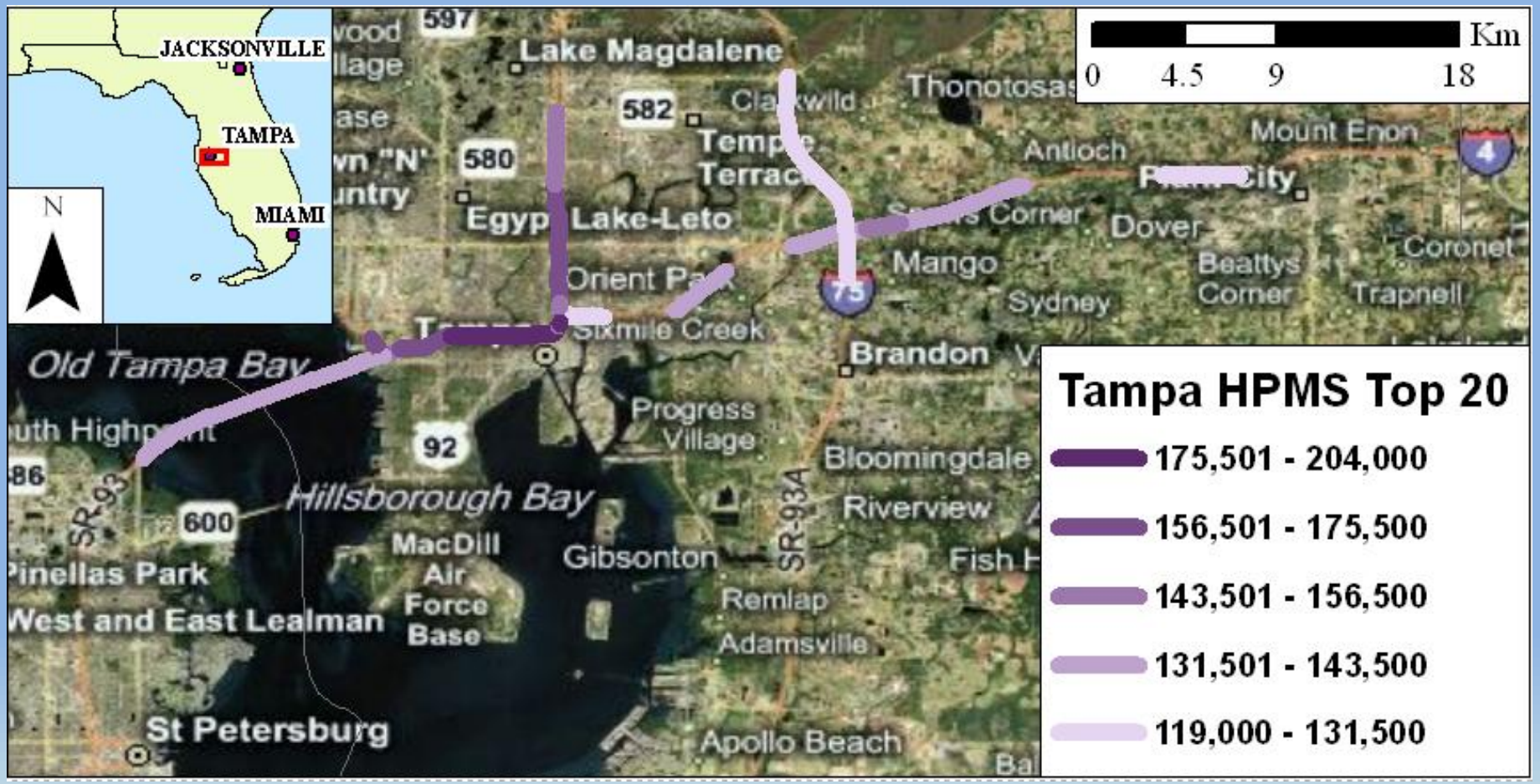


Local Counts
vs.
Local FE AADT
Counts



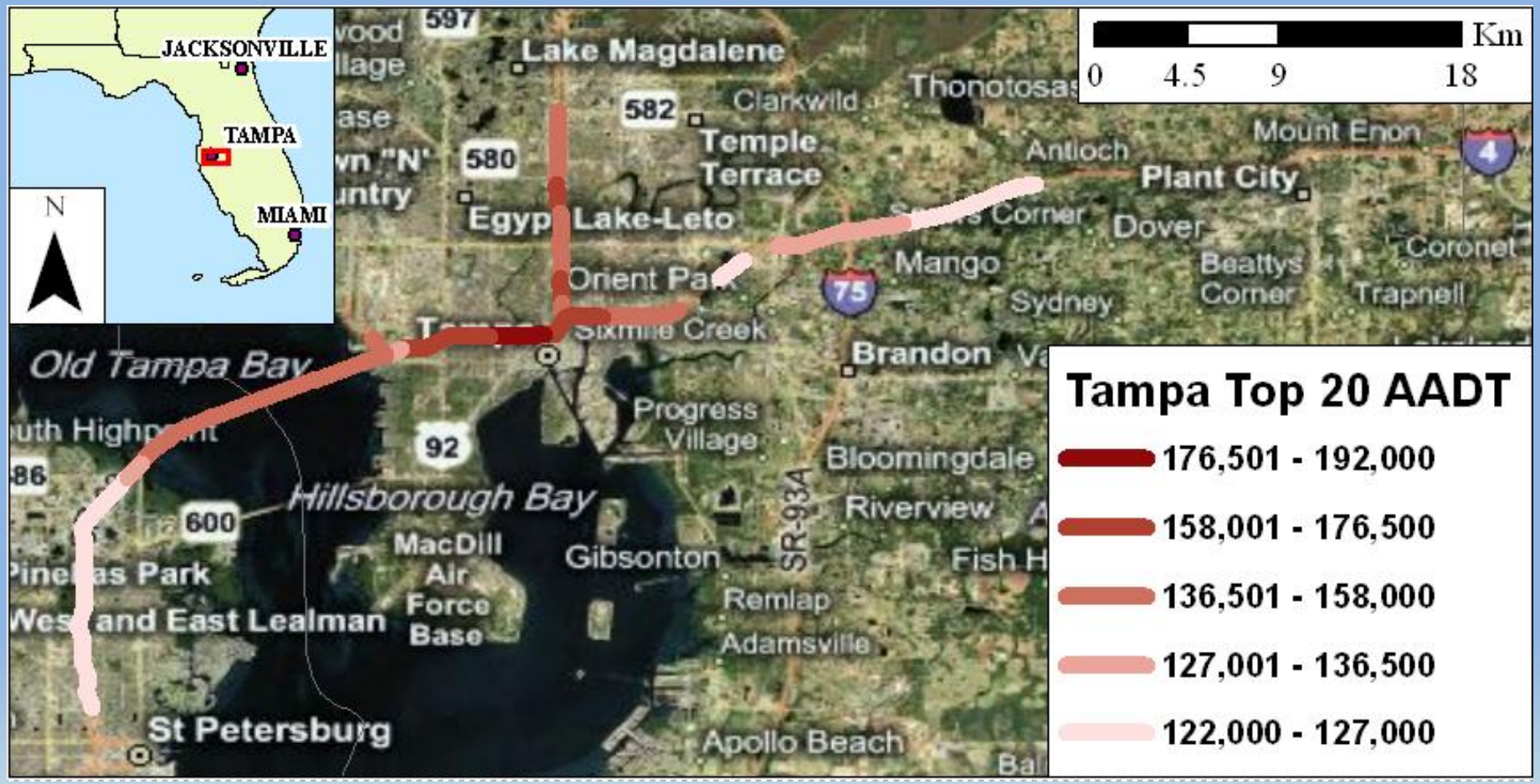
tection

Federal HPMS Data



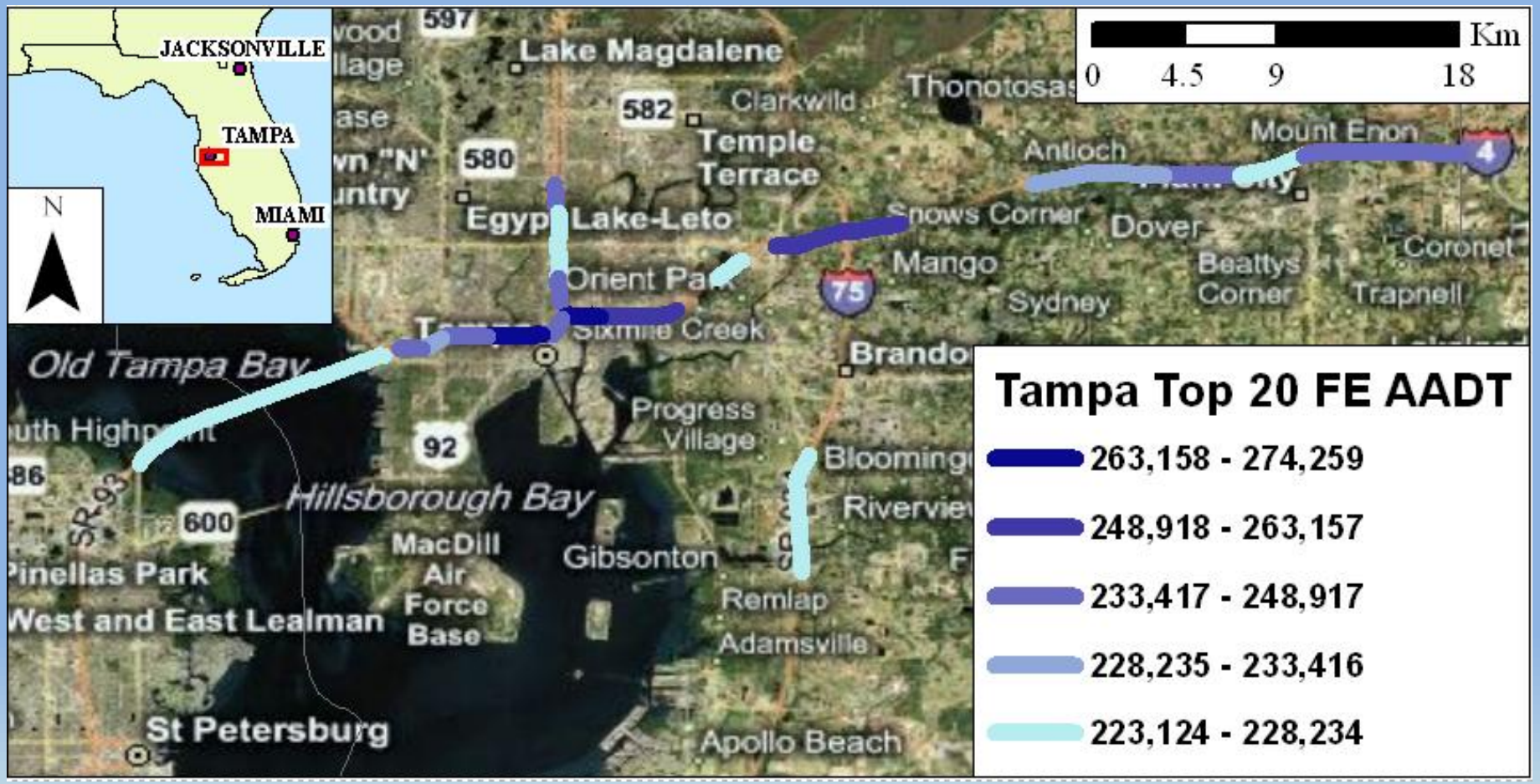
United States Environmental Protection Agency

Local FL DOT Data



EPA United States Environmental Protection Agency

Local Fleet Equivalent Data



EPA United States Environmental Protection Agency

After ranking traffic data…

- Begin road segment evaluation through reconnaissance

- Reconnaissance objectives would relate to:
  - Rule criteria:
    - Roadway design
    - Terrain
    - Meteorology
  - Other factors:
    - Logistical (site placement) feasibility
    - Population exposure (as a secondary factor)

Site Selection

- After any reconnaissance, agencies can begin identifying viable near-road site locations, having considered all the factors in the rule

- Document site selection process and list of potential sites to be included with site proposal in annual network plan

References and Acknowledgements

References:

D.K. Heist, S.G. Perry, L.A. Brixey, A wind tunnel study of the effect of roadway configurations on the dispersion of traffic-related pollution, Atmospheric Environment, Volume 43, Issue 32, October 2009, Pages 5101-5111

R. Baldauf, N. Watkins, D. Heist, C. Bailey, P. Rowley, R. Shores, Near-road air quality monitoring: Factors affecting network design and interpretation of data, Air Quality, Atmosphere & Health, Volume 2, Issue 1, March 2009, Pages 1-9.

Acknowledgements:

Thanks to Nealson Watkins, US EPA OAQPS, for compiling information used in this presentation.

EPA United States Environmental Protection Agency

Questions?

United States Environmental Protection Agency